Bravado of RC Beam and Column Joint by Consumption CFRP & GFRP

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Abstract— Strengthening of existing structures has become a major part of construction activity in our country. Many civil structures are no longer safe due to increased load specifications in the design codes. The beam column joint is the crucial zone in a reinforced concrete moment resisting frame. It is subjected to large forces during severe ground shaking and its behavior has a significant influence on the response of the structure. The assumption of joint being rigid fails to consider the effects of high shear forces developed within the joint. The shear failure is always brittle in nature which is not an acceptable structural performance especially in seismic conditions. The revisions of Indian code provisions have necessitated strengthening of several existing structure in country.

Key words: Deflection, Flexure, Fiber Reinforced Polymers, Strengthening of RC-Beam Columns Joint, Epoxy Resin Etc

I. INTRODUCTION

Strengthening of existing structures has become a major part of construction activity in our country. Many civil engineering structures are no longer safe due to increased load specifications in the design codes. Such structure must be strengthened in order to maintain their serviceability. Strengthening refers to the reconstruction or renewal of any part of an existing building to provide better structural capacity like higher strength and ductility than the original building. Procedure for Paper Submission.

In RC buildings, beam-column joints are subjected to large forces during severe ground shaking and its behavior has a significance influence on the response of the structure. Hence beam-column joint is the crucial zone in a reinforced concrete moment resisting frame. The revisions of Indian code provisions have necessitated strengthening of several existing structure in country. In the analysis of reinforced concrete moment resisting frames the joints are generally assumed as rigid. In Indian practice, the joint is usually neglected for specific design with attention being restricted to provision of sufficient anchorage for beam longitudinal reinforcement. This may be acceptable when the frame is not subjected to earthquake loads. There have been many catastrophic failures reported in the past earthquakes, in particular with Turkey and Taiwan earthquakes occurred in 1999, which have been attributed to beam-column joints. The poor design practice of beam column joints is compounded by the high demand imposed by the adjoining flexural members (beams and columns) in the event of mobilizing their inelastic capacities to dissipate seismic energy. Unsafe design and detailing within the joint region jeopardizes the entire structure, even if other structural members conform to the design requirements

II. MATERIAL AND METHODOLOGY

In this paper two type of material used

A. Carbon fibre Reinforced Polymer (CFRP):

Each carbon filament thread is a bundle of many thousand carbon filaments. A single such filament is a thin tube with a diameter of 5–8 micrometers and consists almost exclusively of carbon. The earliest generation of carbon fibers (e.g. T300, and AS4) had diameters of 7–8 micrometers. Later fibers (e.g. IM6) have diameters that are approximately 5 micrometers. Carbon fiber is an extremely lightweight reinforcing fiber derived from the element carbon.

Fig. 1: CFRP

The carbon atoms are bonded together in crystals, the crystal alignment gives the fiber high strength-to-volume ratio.CARBON FIBRE +PLASTIC RESIN=CFRP

B. Glass Fibre Reinforced Polymer (GFRP):

Fiberglass or GFRP, is a fibre reinforced polymer made of a plastic matrix reinforced by fine fibers of glass. Fiberglass is a lightweight, extremely strong, and robust materials. The plastic matrix may be epoxy, thermosetting plastic.

Fig. 2: GFRP

Common uses of fiberglass include high performance aircrafts, boats, automobiles, baths, hot tubs, water tanks, roofing, pipes, cladding, casts, Surfboards, and external door skins.

Application Procedure of GFRP & CFRP Wrapping:

1) Grinding the surface from joint up to 150 mm and to get an even surface. All projections are grounded off.
2) Apply embraced Primer to be prepared concrete surface area. Work site must be thoroughly ventilated during the application of chemicals.
3) Mix the two packed MBrace Saturant two packs and apply to the primed concrete specimen using brush.
4) The fibre sheet must be cut before application of MBrace Saturant into prescribed sizes using scissors or cutters.
5) On the saturant fix the sized glass fibre carbon fibre sheets and roll in the beam longitudinal direction . [2]

III. RESULTS AND TABLES

Fig. 3: Test setup ordinary specimen.

Fig. 4: Test setup glass specimen.

A. Load Study:

With reference to the test results, the loads on ordinary specimens at first crack stage are compared to the loads on glass fiber specimens at first crack stage. It is observed that the load carrying capacity of glass fiber specimens are increased when compared to the ordinary specimens. From these values the percentage of increase in load carrying capacity of glass fiber specimens over ordinary specimens are tabulated in following table1

No of layers	Load (kN)		Percentage increase in strength
	Ordinary Specimen	GlassFibre Specimen	
1	6.83	8.2	20.05

Table 1: Comparison of load taken by ordinary and GFRP specimen.

Fig. 5: Test setup carbon specimen

B. Load Study:

With reference to the test results, the loads on ordinary specimens at first crack stage are compared to the load on carbon fiber specimens at first crack stage. It is observed that the load carrying capacity of carbon fiber specimens are increased when compared to the ordinary specimens. From these values the percentage of increase in load carrying capacity of carbon fiber specimens over ordinary specimens are tabulated table 2.

No of layers	Load (kN)		Percentage increase in strength
	ordinary Specimen	Carbon Fiber Specimen	
1	6.83	8.6	25.91

Table 2: Comparison of load taken by ordinary and CFRP specimen.

C. Comparative Study of Load Ordinary, CF-Specimen & GF-Specimen:

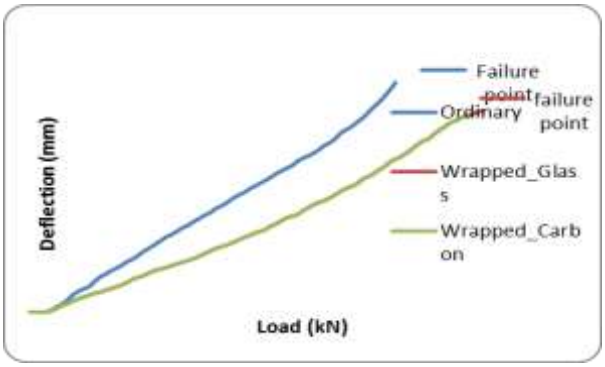

Fig. 6: Graph No 5.13 :Comparative Study of Load Ordinary, CF-Specimen & GF-Specimen

with reference to the test results, the load on ordinary specimens at first crack stage are compared to the load on carbon fiber specimens at first crack stage & load on glass fiber specimens at first crack stage. It is observed that the load carrying capacities of Ordinary specimens are less when compared to the glass & carbon specimens. From these values the percentage of increase in load carrying capacity

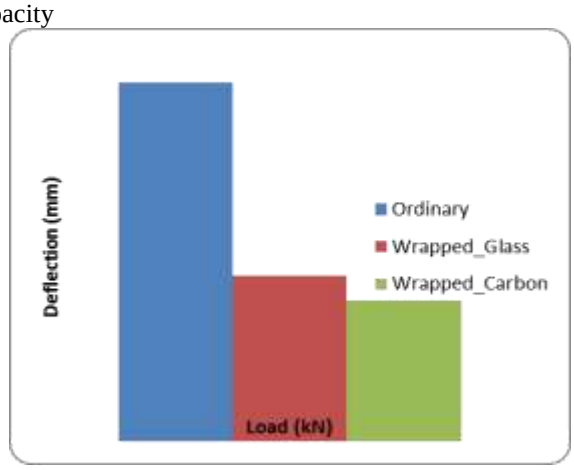

Fig. 7: Graph No 5.14**:** Comparative Study of Load Ordinary, CF-Specimen & GF-Specimen

D. Discussion on Comparative Result:

As per above test result it shows that the total average load of ordinary specimen 6.83KN and carbon fiber specimen 8.6 KN, glass fiber specimen 8.2KN. deflection for 8.26mm will be taken by ordinary and carbon fiber specimen 7.12mm glass fiber specimen 7.13mm.It mean load carrying capacity increase of carbon specimen, glass specimen and decrease deflection compare to ordinary specimen.

IV. CONCLUSION

Based on the experimental investigations carried out on the ordinary and strengthened beam-column joint specimens using GFRP and CFRP wrapping, the following conclusions were drawn.

1) The strengthening technique using wrapping system for the damaged R.C.C interior beam – column joints have proved to be effective.
2) The rigidity and ultimate load carrying capacity of the strengthened beam was improved with decrease in deflections.
3) Glass composite materials can be efficiently used for strengthening and rehabilitation of reinforced concrete joints.
4) Joints can exhibit enhanced performance for different reinforcement detailing and damage states.
5) Considerable increase in yield load can be achieved by use of glass reinforced polymer materials.
6) Considerable increase in first crack load can be achieved by using glass reinforced polymers.
7) The strengthened specimens are stiffer than the ordinary specimen and the crack widths in the rehabilitated specimens are relatively less.
8) And also as per non-destructive test of pulse velocity method concrete quality is good.

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REFERENCES

[1] Granata P.J., and Parvin A.,(2001): "An Experimental Study on Kevlar Strengthening of Beam-Column Connections, Composite Structures" Vol. 53, pp. 163-171.
[2] Dr. Gopal Rai 1and Yogesh Indolia **"**Fiber reinforced polymer composites a novel way for strengthening structures" National Conference on Repair and Rehabilitation of Concrete Structures Noida, UP, India May 6-7, 2011.
[3] L. C. Hollaway "Key issues in the use of fiber reinforced polymer (FRP) composites in the rehabilitation and retrofitting of concrete structures" University of Surrey, UK © Woodhead Publishing Limited, 2011.
[4] M. Dawood and S. Rizkalla "Development of a Carbon Fiber Reinforced Polymer System for Strengthening and Repair of Steel Bridges and Structures" 2nd Canadian Conference on Effective Design of Structures McMaster University Hamilton, Ontario, Canada May 20 – 23, 2008.
[5] N.Vijayalakshmi, M.Kalaivani, A.Murugesan & G.S.Thirugnanam "Experimental Investigation of RC-Beam" International Journal Of Civil And Structural Engineering Volume 1, No 1, 2010.
[6] V.Ravindra & R.V.Ramkrishna, "Experimental investigation on Rehabilitation of reinforced Cement concrete interior Beam-column joints using CFRP and GFRP sheets", International Journal of Engineering Science and Technology (IJEST), vol 2,page no 875-881.
[7] Maariappan & R. "SingaravadivelanStudies on Behaviour of Rcc Beam-Column Joint Retrofitted" with Basalt Fiber Reinforced Polymer Sheet, G. Global Journal of Researches in Engineering. Civil And Structural Engineering ,Volume 13 Issue 5 Version 1.0 Year 2013
[8] Ugale Ashish B. and Raut Harshalata R. "Investigation on Behaviour of Reinforced Concrete Beam Column Joints Retrofitted with FRP Wrapping", International Journal of Civil Engineering Research. ISSN 2278-3652 Volume 5, Number 3 (2014), pp. 289-294
[9] Prof. A. Meher Prasad & Dr.S.R.Uma, "Seismic Behavior of Beam Column Joints in Reinforced Concrete Moment Resisting Frames". Document No: IITK-GSDMA-EQ31-Vol 1. page no 2-5
[10] Mukherjee A., and Joshi M., (2005): FRPC Reinforced Concrete Beam-Column Joints under Cyclic Excitation, Composite Structures, Vol.70, pp. 185-199.

